Transcription of Proposer's Day Workshop, May 16, 2006

Q: Will we be able to get copies of the View Graphs?
A: View Graphs will be posted on the Frequently Asked Questions website.

Q: Would DARPA be able to provide Silicon carbide devices or does the team have to team with one of two companies completed in phase 2?
A: DARPA will not provide the devices. Companies funded in the Phase II program are: CREE, Northrop Grumman Electronic Systems and Purdue University.

Q: Is EMC (ie: MS461E) an important 'shipboard requirement' that the SSPS will have to meet?
A: Yes, 461E middle standard is one of the requirements and will be tested.

Q How important is EMI immunity?
A: It has to be met.

Q: When does the technical need to be demonstrated by in order to get on the lead ship?
A: As you saw in previous slides, to meet ship building schedule, continue to meet arrangements with the technology that exists today. That means, we're developing the arrangements of the various spaces that include these transformers. Also, if we have a modular design, later insert transformer after/during test program and do not disrupt the schedule. Real answer is, as we get closer to being competent during the testing of this transformer with achievable technology, then we can decide what it takes to get to ship board qualification, and we'll make a decision.

Q: What readiness level is required before the Navy will consider technology for inclusion?
A: You have to meet all shipboard qualifications prior to transfer shipboard. We're going to test the unit at some test site, we will then determine if it meets functional requirement. Then commit to shipboard qualification, but can't go on ship until it has met all shipboard qualifications.

Q: Please elaborate on modularity w.r.t. late installation.
A: Our ship building strategy is to build the ship bottom up. Transformers are not designed to be replaceable; they're without major cutting, so they are reliable. Strategy would be to put in ship after met qualifications, and the deck over that space wouldn't be complete, so do some modular installation so we don't have to do full cuts or anything major removals to get this thing into it. That's why we prefer modular.

Q: Regarding selecting optimum topology as a challenge, the BAA implies a specific solution, do we have flexibility to define a different topology we feel is optimal?
A: You have flexibility, but it must include galvanic isolation.

Q: Funding for future development?
A: Yes, there is funding for future development.

Q: Can silicon carbide be government furnished equipment?
A: No.

Q: Has the government selected test facility for independent demo?
A: No.

Q: What role would contractor play in demonstrator's test?
A: The contractor will be an integral part in the actual testing, but it will be a government led test.

Q: Is there a down select after base effort?
A: Hard to tell at this point.

Q: Total funding available per year?
A: Hard to tell at this point. You need to propose what is necessary to get job done as efficiently as possible.

Q: Are there technologies other than silicon carbide that must be used in this effort?
A: Absolutely, a lot of technologies other than silicon carbide. There's high frequency transformer, thermal considerations, packaging considerations. This program goes beyond the SiC material through systems level technologies.

Q: Is the intelligent universal transformer topology the desired demo topology?
A: No, there is no desired demo topology.

Q: Have there been any SSPS studies done during phase 2, and how do you get them?
A: A SSPS design study was completed. The viewgraphs that were presented will be on the FAQ website. When the study is approved for public release it will also be on the website.

Q: Does DARPA expect all competitive teams to be able to get devices from Cree and Northrop Grumman. Will they be available in package form or bare dice?
A: This is not government furnished equipment. There was considerable thought here, we're trying not to lock you into a particular design with particular devices. We were trying to leave options available, to allow you to think outside of the box, so you weren't locked into specific devices. The devices will be what you work out with whichever supplier.
Q: To start, do you expect a phase 2 device performance available to competitive teams prior to proposal delivery date?

A: Right now were in the middle of phase 2, we have about 8 months left. To stay up to date, is it suggested that you contact Phase 2 contractors individually to get device status.

Q: Please clarify definition of engineering model. Is it a single phase system of basic program or 3 phase system of option program?
A: Engineering model is the prototype design. For phase A, it's a single phase, and phase b, it's the completed 3 phase design.

Q: Does the program need to meet all requirements and will there be a design update?
A: There are a lot of requirements: shock, vibration, thermal, all of these things need to have been thought about in your design. In prototype design, you're not going to have to test for all of those, but you still need a plan put together, that will pass these tests. On the full three phase system thermal management must be demonstrated.

Q: In table 1, the BAA proposer information gives weight and volume metrics for magnetic elements. What are these metrics for the complete SSPS?
A: We didn't say. We stated it for the magnetic element, if recall back to my talk, the reason to go back to high frequency transformer is to take out weight and size. Weight and size increase owing to addition of front and back end converters must be more than offset by the weight and size decrease owing to the high frequency transformer. (As well, other magnetic elements besides the high frequency transformers need to do the same.) If an input converter topology is chosen that requires large line reactors at 60 Hz, we aren't saving weight. So we wanted look at all magnetic elements in design, and if you haven't saved any weight in the magnetic element, there's no point in moving forward, because when you put converters on top of that then there will be no trade space. So that's why we focused on magnetic elements. We weren't certain on packaging for silicon carbide devices, pooling arrangements that would be made, that's why we didn't specify total system.

Q: How is the volume and weight of three single phase converters compared with those for one three phase converter?
A: There is a difference in terms of the transfer weight, but not a big difference, so we chose to ignore because they're really close. In our trade study, when we looked at the differences in the device count for the single 3 phase 4 level topology and three single phase 3 level topologies, depending on how you did paralleling for the current, the device count was almost identical. If you used device count as a surrogate for size and weight, other big elements in there are bus capacitors and link capacitors they are really very close, so making decision came from other qualities in deciding between the two, they were pretty close to a dead heat without an absolute number.

Q: Please expand on traits for 3 by 1 phase, or 1 by 3 phase; you seem to jump right to the 3 by 1, what are the issues of 1 by 3 that drove you that way?

A: The single 3 phase, if you lose a device, you stop having 3 phase power unless you put a lot of redundancy in the design. Three single phase, you can take out one of the 3 single phase units and you still have 2, but then you have to worry about balance load, but your still in business for a while. That was the consideration.

Q: The BAA specifies 97% efficiency for the three phase system at full load; does this number include the output low voltage inverter?
A: Yes, We put what we thought were going to be challenging numbers here for efficiency, and given the model simulation for the topologies we looked at, 97% would be extremely challenging if you include the output low voltage inverter. If you did, integral 3 phase SSPS, three out of three phase four level input rectifier inverter, transformer, output rectifier, and then a single inverter to 450 volt, 97% would be tough to make, but not impossible.

Q: Is there a duration associated with the 180% overload condition?
A: Yes, we chose the number from the IMTP system for DX. It is a matter of seconds, not minutes. It was associated with current for downstream of the converter, were back to requirement for work inside the power system.

Q: What are the transient specifications of the 13.8 kV?
A: It's an adaptation of 1399 for the 13.8 kV system. If you are used to 1399, this isn't anything new, just adjusted for 13.8kV like a 40 volt system.

Q: Does neutral connection need to carry load current or only for high impedance ground on the 450 side?
A: The 450 side is ungrounded, it's high impedance grounded on this application through the neutral. The neutral doesn't carry load current.

Q: Is the shipboard transformer required to meet impulse (95 kV) and dielectric tests (36 kV) as is required of the present transformers? This requirement was not identified in the design panel presentation.
A: Yes.

Q: Is the unity power factor at full load, and does it drop off at lower load levels? Will it always be unity power level factor?
A: No reason why it can't maintain unity power factor at lighter loads. Problem is that there are high loads that are harder to control, have to keep in hexagon, and to maintain control current, within circle, that just touches hexagon. The ratio of the radius to hexagon is a line to line voltage. All single phases stay on lower lines

Q: What is the current status of silicon carbide IGBT?
A: There are still plans, viable strategy for developing from prime contractors, Northrop Grumman Electronic Systems, CREE and Purdue, discuss with them what their delivery

schedules might be. The MOSFET is much more likely to be sooner than IGBT. So, silicon carbide devices will be available at the end of phase 2 with the ratings required. The IGBT is likely to take longer.

Q: What are the engineering reasoning and trades for selecting 110 amp volts for phase 2 module?
A: The study group looked at the required specifications for existing transformer, copper iron transformer, came up with about 160. It depends on topology. Typically, modules are made in families of different currents. You can make 50/100/150/200 amp with same technology, so development of technology is similar with those current ranges. You should determine requirements for their design and then discuss with prime contractor in phase 2. It's left to you to decide what is required and what is developed in phase 2 is consistent with that full range that we discussed.

Q: Topologies are a function of voltage capability. A 10kV SiC MOSFET leads to a different topology than a 20kV SiC IGBT. Isn't this a moving target, how do we firm up the design in short term versus long term?
A: This is the crux of the BAA exercise. The simple answer is there's a target, there's a deliverable, there's an application, all of which forces you to make deliverables with things that are available. It is the creativity that we're looking for, if you offer designs that scale to take in higher level applications, that's going to be appreciated. Important to note that design team was primed to answer the question whether it was possible to take an assembled solution from the scheduled available technology.

Q: Are the silicon carbide producers barred from priming on BAA 06-30?
A: No. It is an open BAA.

Q: What are your thoughts and feelings on single 3 phase topology that will operate through the loss of one phase?
A: We have an open mind about it. We're not claiming our determination is the conclusive decision. If there's a topology that offers graceful degradation, we'd certainly consider it with others.